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NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS) PREPARATORY PROJECT (NPP)

RISK MANAGEMENT PLAN (RMP)

January 21, 2000

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

INTEGRATED PROGRAM OFFICE
SILVER SPRING, MARYLAND

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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of the National Polar-orbiting Operational Satellite System (NPOESS) Preparatory Project (NPP) Risk Management Plan (RMP) is to:

- Provide a disciplined and documented approach to risk management throughout the project life cycle
- Support management decision making by providing integrated risk assessments (taking into account cost, schedule, performance and safety concerns)
- Communicate to management the significance of assessed risk levels and the decisions made with respect to them.

1.2 SCOPE

The NPP RMP encompasses all development, integration and testing, and operations activities and products for National Aeronautics and Space Administration (NASA) and the NPOESS Integrated Project Office (IPO).

1.3 NPP SYSTEM OVERVIEW

The NPP is a joint mission being formulated by NASA and the NPOESS IPO. The NPP mission provides remotely sensed land and atmospheric data that serves the meteorological and global climate change communities.

The NPP mission is considered a bridge between the Earth Observing System (EOS) and the NPOESS programs. The mission provides continuity of climate data measurements for NASA and risk reduction for the NPOESS IPO.

The NPP mission is to accomplish the following objectives:

- Demonstrate and validate global environmental imaging and sounding instruments, algorithms and pre-operational ground system processing capabilities in order to provide risk reduction to the first NPOESS flight.

- Provide continuity of the calibrated, validated and geo-located EOS Terra and Aqua systematic global imaging and sounding observations for NASA Earth Science research.

For mission definition and formulation purposes, the NPP System is defined at the highest level in terms of six segments. These segments are used for the purpose of describing the System with the understanding that some functions currently found within one segment may ultimately be implemented in another segment, should it be deemed appropriate.

- Space Segment

The Space Segment (SS) consists of the satellite and ground support equipment (GSE). The satellite is comprised of the spacecraft and instruments. The instrument complement includes: Visible-Infrared Imager Radiometer Suite (VIIRS), Cross-Track Infrared Sounder (CrIS), and the Advanced Technology Microwave Sounder (ATMS). The possibility of an instrument of opportunity (IOO) is still being evaluated, but preliminary information for an IOO is included.

The NPP is planned for an 833 km polar, sun-synchronous orbit with a 10:30 am descending node, equatorial crossing time. Sensor data are acquired continuously, stored onboard and are subsequently down linked to polar ground stations for capture, preprocessing, and routing to the processing sites within the United States. Additionally, a continuous, real-time direct broadcast capability is planned for transmitting all instrument and auxiliary data to users equipped to receive these data.

- Command, Control and Communications Segment

The Command, Control and Communications (C3) Segment provides the NPP satellite operations capabilities, communication routing of mission data, and the ground receive stations. The C3 Segment also provides for the overall mission management and coordination of the joint program operations needs. Mission Management represents both the operational and scientific communities.

The satellite operations capabilities include mission planning and scheduling, resource coordination, building, verifying and sending of command loads, and maintenance of spacecraft databases. Off-line activities include spacecraft simulation, flight software maintenance, mission trending and analysis, and as necessary, anomaly resolution. The communication routing functions include those activities associated with the planning, scheduling and coordination of network communication links. The polar ground station coordination and intra-segment communication services are also provided.

- Interface Data Processing Segment

The Interface Data Processing Segment (IDPS) provides for ingest of raw sensor data and telemetry received from the polar ground stations. The artifacts from the communication routing are removed, providing raw data records (RDRs) which are subsequently processed to create Sensor Data Records (SDRs) and Environmental Data Records (EDRs). The RDRs, SDRs, and EDRs are made available to five meteorological Centrals for use in application specific weather related predictions. The five centrals are:

- National Environmental Satellite, Data, and Information Service (NESDIS)
- Air Force Weather Agency,
- 55th Space Weather Squadron,
- Fleet Numerical Meteorology and Oceanography Center (FNMOC), and
- Naval Oceanographic Office (NAVOCEANO).

The data records are provided to the Centrals on a time critical basis (three hours from sensor acquisition), although as a pre-operational demonstration, this timeliness is

viewed as a goal rather than an operational requirement. Additionally, the IDPS also provides an operational level of calibration and validation of the algorithms and the performance of the payload sensors. The RDRs, SDRs, and EDRs are forwarded to the Archive and Distribution Segment (ADS) for archiving and broader user access. The RDRs are provided to the SDS for science unique processing.

- Science Data Segment

The Science Data Segment (SDS) ingests the RDRs from the IDPS. The SDS validates format and volume/size of the RDRs, ensuring all data are received. The SDS processes the RDRs, creating a Level 1B product. The Level 1B is comparable to the IDPS SDR product, but will be generated using more robust, science quality algorithms. The RDRs are stored in the SDS for the life of the mission, permitting reprocessing when improved science algorithms are made available from the science community.

The Level 1B data are provided to a small, competitively selected science user group who are responsible for generating identified Level 2/3 science products. These products are unique to the science research community or represent a significant science improvement beyond the IDPS EDRs. To the extent feasible, the EDRs are planned to serve the global change community, in addition to the operational weather community, minimizing the extent and scope of the SDS. It is intended that the SDS algorithms be coordinated with the Centrals and ultimately be incorporated as part of their nominal routine processing. The SDS also performs science calibration and validation and coordinates with the IDPS on results, and as necessary, calibration file changes. All Level 1B and Level 2/3 products are provided to the ADS, thereby providing wide user access to all science products.

- Archive and Distribution Segment

The ADS receives the RDRs, SDRs, and EDRs from the IDPS and the Level 1B and Level 2/3 products from the SDS. All of these data are archived, as are the associated metadata upon which users may search and order data. Upon request, data products are distributed to users who are billed for the cost of fulfilling the request.

- Launch Service Segment

The Launch Service Segment (LSS) provides those assets and services associated with the launch vehicle (LV) and the payload integration. Included, along with the launch vehicle, are all ground support equipment, property, and facilities necessary to integrate the spacecraft to the LV, verify their integration, and conduct pre-launch testing with the remainder of the ground system.

2.0 RISK MANAGEMENT OVERVIEW

2.1 DEFINITIONS

- Risk – An undesirable situation or circumstance that has a realistic probability of occurring and an unfavorable consequence on the overall mission success.

- Risk Management – A systematic decision-making process that efficiently identifies risks, assesses risk levels, and effectively reduces or mitigates risks to achieve mission goals.

2.2 COMPONENTS OF RISK

There are two components of risk: probability and consequence. An increase in the probability that a failure will occur, in combination with an increase in the negative consequence of a failure, results in increased mission risk.

Figure 2.2-1 illustrates the relationship between probability and consequence.

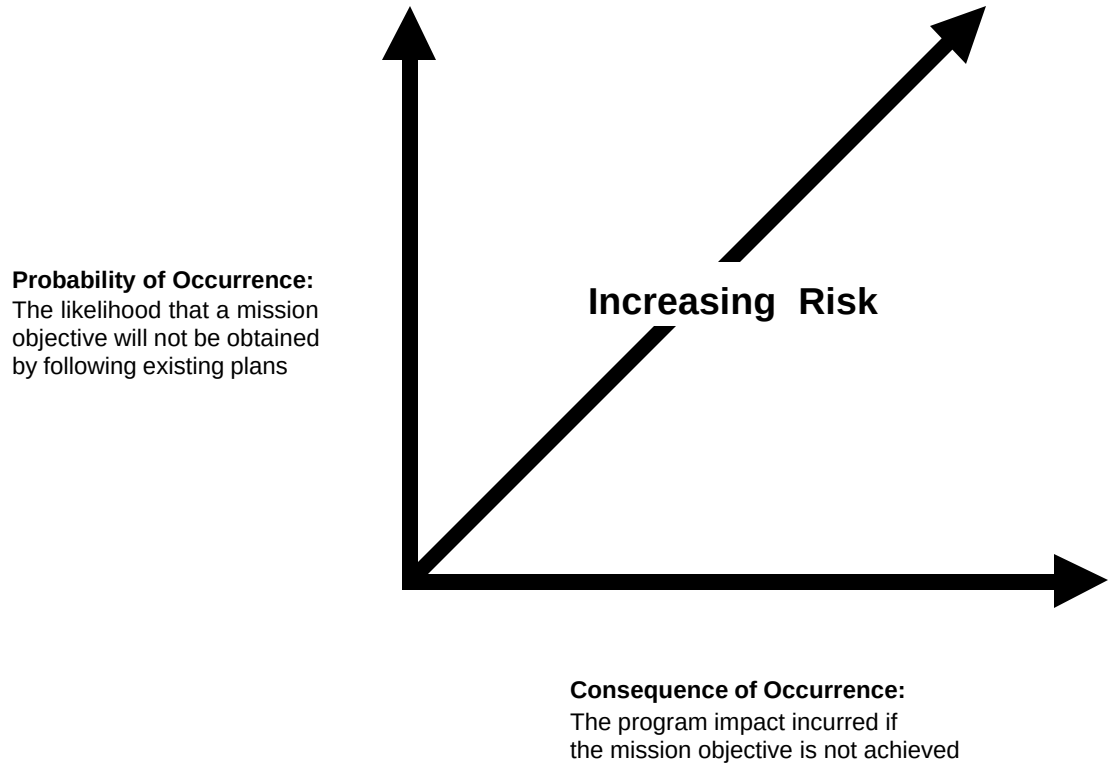

Figure 2.2-1. Risk Components

2.3 RISK LEVELS

There are three risk levels:

- High – Likely to cause significant, serious disruption of schedule, increase in cost, and/or degradation of performance, even with special project emphasis.

- Medium – Can potentially cause disruption of schedule, increase in cost, and/or degradation of performance. Special project emphasis will probably be sufficient to overcome issues.

- Low – Has little or no potential for disruption of schedule, increase in cost, and/or degradation of performance. Normal project activities will probably be sufficient to overcome issues.

2.4 IDENTIFYING, EVALUATING AND REDUCING RISK

There are five basic questions that must be answered during the risk management process (described in Section 3.0) in order to identify, evaluate, and reduce risk levels within the NPP. These questions are:

1. What can go wrong?

2. How likely is it?

3. What are the consequences?

4. What are we going to do about it?

5. Are things getting better or worse?

3.0 RISK MANAGEMENT PROCESS

3.1 RISK MANAGEMENT PHASES

The NPP risk management process consists of four steps:

1. Risk Identification: Identify possible risks, and determine root causes

2. Risk Analysis: Determine probability of occurrence, and determine most likely consequence of identified risk

3. Risk Control: Identify potential risk reduction actions, and analyze and prioritize changes to existing plans

4. Risk Reduction Plan Implementation and Risk Tracking: Modify program plans, to include risk reduction plans, and monitor residual risks. Track and report status to management of all risk items.

NPP documentation and information used during the risk management process include the Work Breakdown Structure (WBS), Program Implementation Plan (including cost and schedule), Segment Specifications, architecture descriptions, Performance Verification Plan, and System Integration and Test Plan. Other lower level documents include design specifications, interface descriptions, and others.

The resulting effort of the risk management process is to execute the identified risk reduction plan at the appropriate management or technical level, and to regularly update and provide status to management on all potential and identified risks. Additionally, each segment is continuously evaluated for potential risks through the formulation and implementation phases.

Figure 3.1-1 summarizes the risk management steps.

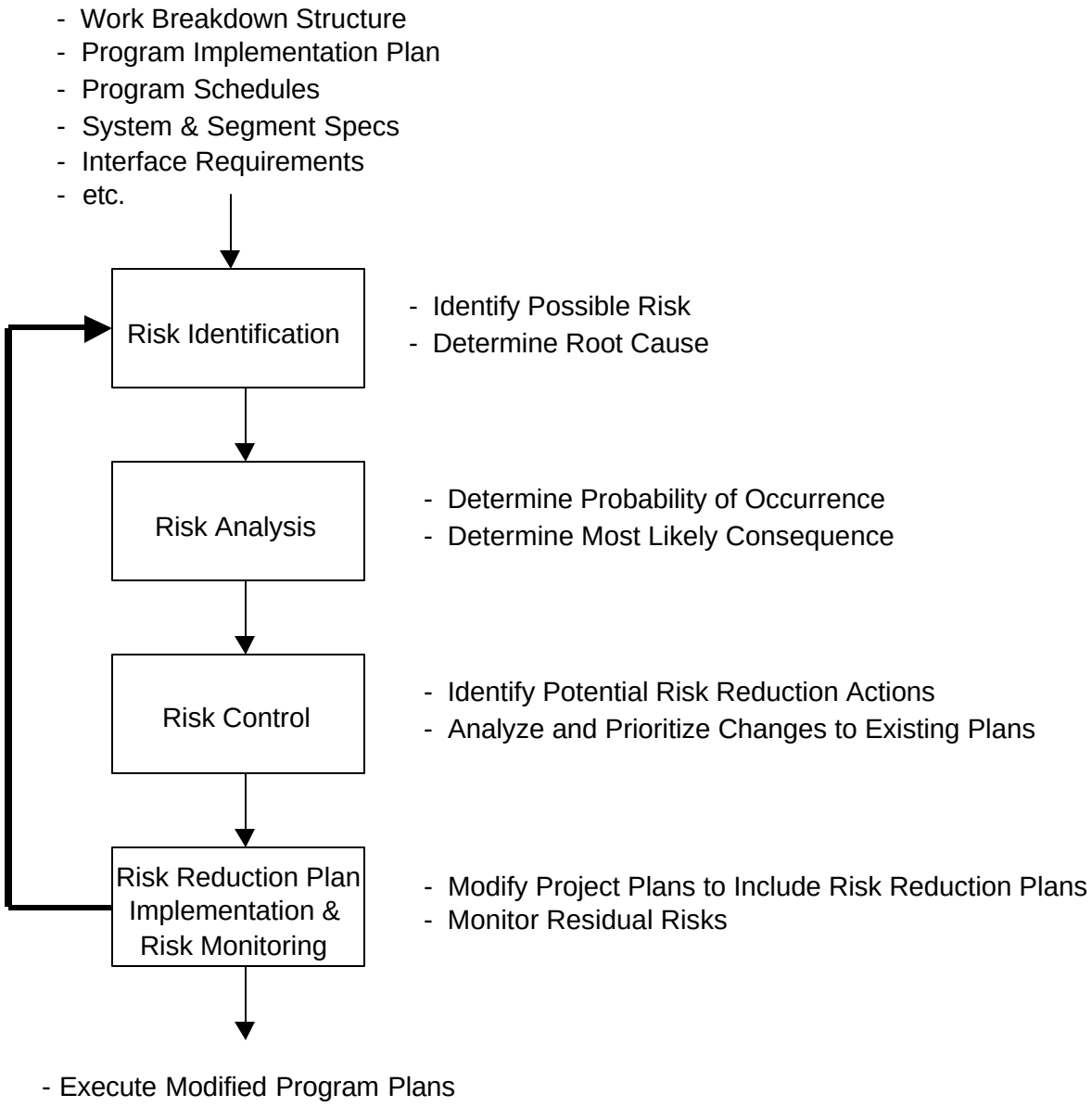

Figure 3.1-1. Risk Management Steps

3.1.1 Risk Identification

Risks may be identified at any level of the program, from technical development issues, schedule delays, or project funding. Risks may be identified by several methods including expert experience, trend analysis, cost-performance modeling, and others. One of the most essential risk management tools is communication between NPP team members and project management. Risks cannot be mitigated without changes in direction or management support.

3.1.2 Risk Analysis

Once a risk has been identified, the probability of it occurring is analyzed and the consequence of failure is determined. There are several methods for determining the probability of a failure occurring and its consequence, including expert evaluation, probability analysis, parametric analysis, and commercial risk management tools.

Each risk is categorized for probability and consequence according to the following levels:

Probability (Likelihood):

What is the likelihood of this risk?	
Level	**Likelihood**
1	Planned project activities are sufficient to prevent this event.
2	Planned project activities are usually sufficient to prevent this type of risk.
3	Planned project activities may prevent this event, although additional actions will be required.
4	Planned project activities cannot prevent this risk from occurring, although a different approach or process might.
5	Planned project activities cannot prevent this risk from occurring; no alternate approaches or process are available.

Figure 3.1.2-1. Likelihood Levels

Consequence:

Given that this risk occurs, what is the magnitude of the impact?					
Level >>	1	2	3	4	5
Technical	Minimal or no impact	Moderate reduction, same approach retained	Moderate reduction, but workarounds available	Major reduction, but workarounds available	Strategic reduction, no workarounds available
Schedule	Minimal or no impact	Additional activities required. Able to meet need dates.	Key milestone slip ≤ 1 month	Key milestone slip > 1 month, or critical path impacte	Cannot achieve key or major project milestone
Cost	Minimal or no impact	Budget increase < 5%	Budget increase > 5% or other teams impacted	Budget increase > 10%	Budget increase > 15%

Figure 3.1.2-2. Consequence Levels

Based upon the level of likelihood and consequence, each risk is mapped into the following matrix:

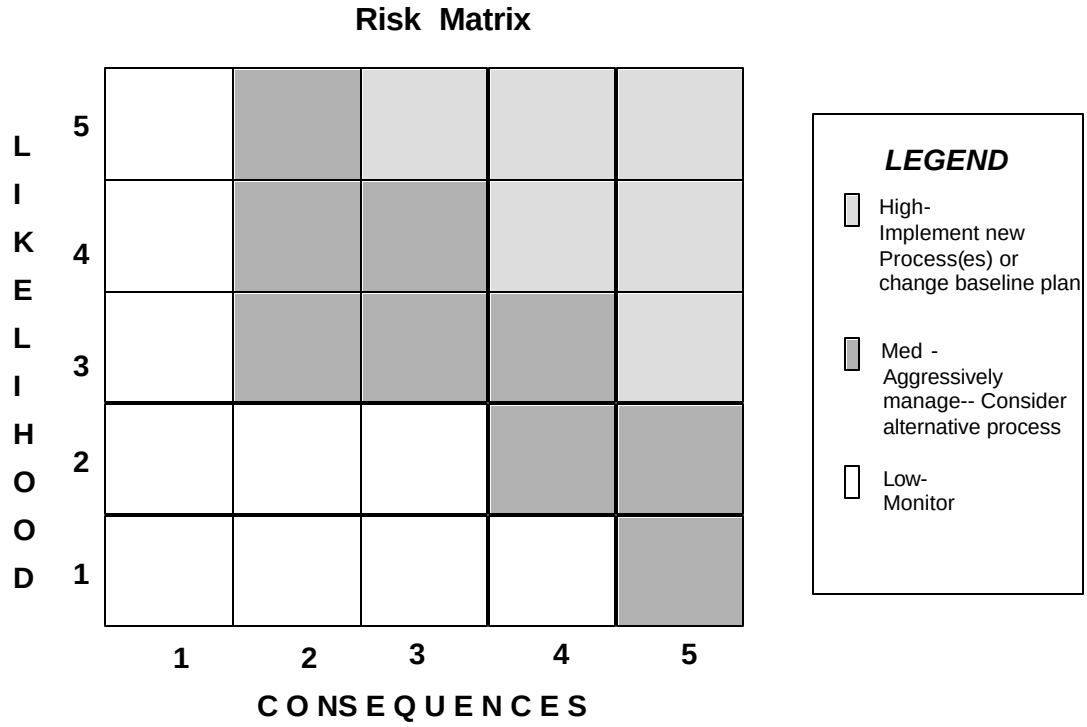

Figure 3.1.2-3. Risk Matrix

3.1.3 Risk Control

Each risk that is mapped into the risk matrix falls into one of three risk levels; high, medium or low. Program actions to mitigate identified risks are based upon the risk level as follows:

- Risks identified as “High” require special attention in the form of mitigation plans. Mitigation plans may take the form of decision trees, alternate development or operational approaches, changes in scheduling or cost profiles. Documentation for the mitigation plans is required. The status of each “High” risk and the associated mitigation plan is presented to NPP management weekly.

- Risks identified as “Medium” require special attention in the form of weekly status to project management. Project management may request mitigation plans be developed if deemed necessary. “Medium” risks are evaluated each week to determine if the issue is improving or deteriorating.

- Risks identified as “Low” do not require special attention. Project management may direct lower level activities be performed to monitor the issue to determine if the situation deteriorates.

3.1.4 Risk Reduction Plan Implementation and Risk Tracking

The implementation of a risk reduction or mitigation plan is authorized by project management and is reviewed weekly. The risk reduction plan is evaluated weekly for indications of improvement (or degradation) in performance, cost, or schedule. The plan may be re-evaluated or modified if conditions do not improve.

The management of a risk reduction plan will be assigned to a specific Segment or Mission Manager who will track progress and report status back to NPP Management.

3.2 RISK MANAGEMENT TOOLS

There are several tools available for evaluating and tracking/categorizing risks. Tools that support tracking and categorizing risks include the NASA Risk Management System and Mesa-Vista. The risk tracking and categorization tool is under the supervision of the NPP Systems Manager. The selected tool will have the capability to generate metric reports such as number of open/closed risks, number of high risks, and etc.

3.3 ROLES AND RESPONSIBILITIES

3.3.1 Segment Management Responsibilities

It is the responsibility of each segment manager to identify possible risk items utilizing methods and tools that are common practice within industry and government. Once a risk has been identified, the segment manager assigns the level of likelihood and consequence. It is then reviewed with the NPP System Manager.

Once a risk item has been agreed upon by both the Segment Manager and the NPP System Manager, it is reported to program management and entered into the risk management tool.

3.3.2 NPP System Manager Responsibilities

The Mission System Manager is responsible for coordinating with the Segment Managers and other NPP members to ensure that the project is continuously analyzed for risks threats and that each identified risk is properly tracked and reported. The NPP Systems Manager is also responsible for identifying risk between segments and across development, testing, and operation activities.

The risk management tool is under the supervision of the NPP Systems Manager. It is his/her responsibility to ensure that risks items are entered into the tool and properly updated. The NPP Systems Manager will generate reports from the risk management tool that provides the status of all the risks in the system and will report this status to management weekly. Metrics from the risk management tool, such as number of risks open, number of risks closed, and number of high risks, will be reported monthly.

When a mitigation plan is approved by NPP Management, the NPP Systems Manager is responsible for ensuring that the technical aspects of such plans are implemented along with the appropriate Segment Manager or other NPP members.

3.3.3 NPP Management Responsibilities

It is the responsibility of the NPP Manager to ensure that 1) the project is continuously evaluated for risk areas, 2) that risks are properly tracked and reported, and 3) that risk reduction plans are implemented and reported. The NPP Manager is also responsible for reporting risk to program levels.

3.3.4 Risk Reviews/Meetings

Technical risk reviews and/or coordination meetings are at the discretion of the NPP System Manager. Risks may be reviewed weekly, bi-weekly, or monthly depending on the number and criticality of the risks identified. For instance, risks may be reviewed during the weekly NPP System Engineering Working Group, which is led by the System Manager.

4.0 RISK ITEM DEFINITION

When a risk item is identified and accepted, the following information will be defined and captured:

- Risk Title: a short descriptive phrase that characterizes the risk
- Risk Summary: a one or two paragraph description that provides a detail explanation of the risk and associated impact
- Likelihood of occurrence: a numerical value from 1-5 based on Figure 3.1.2-1.
- Consequence of occurrence: a numerical value from 1-5 based on Figure 3.1.2-2.
- Risk level: High/Medium/Low, based on Figure 3.1.2-3.
- Originator: person who identified risk item
- Responsible party: person (or position) who is responsible for reporting and tracking the risk item
- Actions/status: record of any actions or current status of risk item
- Mitigation plan: for those risks that have a mitigation plan, the mitigation plan documents the steps/actions to address the risk.

Appendix A Acronym List

ADS	Archive and Distribution Segment
ATMS	Advanced Technology Microwave Sounder
C3	Command, Control and Communications Segment
EDRs	Environmental Data Records
EOS	Earth Observing System
FNMOC	Fleet Numerical Meteorology and Oceanography Center
GSE	Ground Support Equipment
IDPS	Interface Data Processing Segment
IOO	Instrument of Opportunity
IPO	Integrated Program Office
LSS	Launch Service Segment
LV	Launch Vehicle
NASA	National Aeronautics and Space Administration
NAVOCEANO	Naval Oceanographic Office
NESDIS	National Environmental Satellite, Data, and Information Service
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
RDRs	Raw Data Records
RMP	Risk Management Plan
SDRs	Sensor Data Records
SDS	Science Data Segment
SS	Space System
VIIRS	Visible-Infrared Imager Radiometer Suite
WBS	Work Breakdown Structure

Appendix B NPP Risk Management Reference Card

What is the likelihood of this risk occurring?	
Level	**Likelihood**
1	Planned project activities are sufficient to prevent this event
2	Planned project activities are usually sufficient to prevent this type of risk
3	Planned project activities may prevent this event, although additional actions will be required
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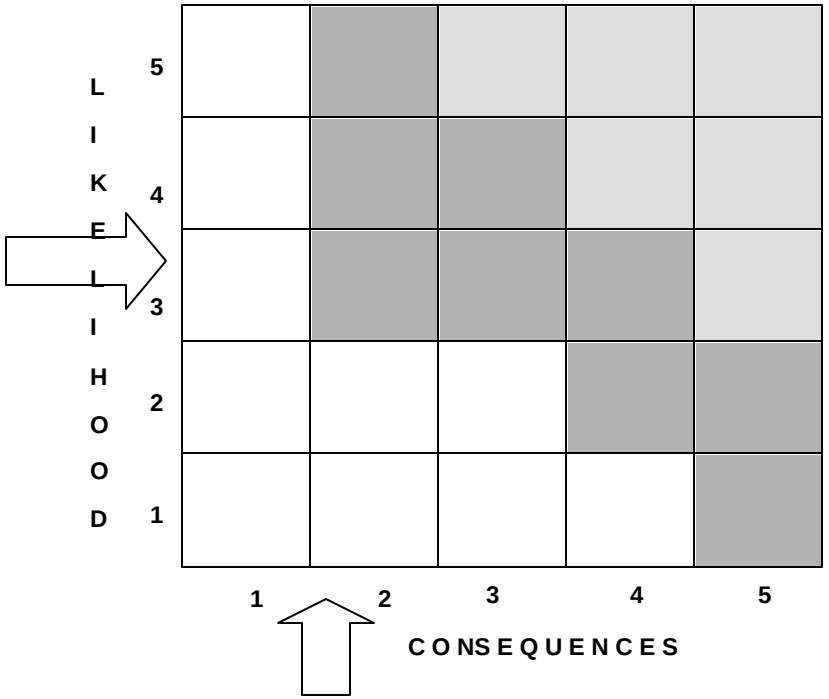
Risk Matrix



Given that this risk occurs, what is the magnitude of the impact?					
Level >>	1	2	3	4	5
Technical	Minimal or no impact	Moderate reduction, same approach retained	Moderate reduction, but workarounds available	Major reduction, but workarounds available	Strategic reduction, no workarounds available
Schedule	Minimal or no impact	Additional activities required. Able to meet need dates.	Key milestone slip ≤ 1 month	Key milestone slip > 1 month, or critical path impacte	Cannot achieve key or major project milestone
Cost	Minimal or no impact	Budget increase < 5%	Budget increase > 5% or other teams impacted	Budget increase > 10%	Budget increase > 15%

LEGEND

- High- Implement new process(es) or change baseline plan
- Medium- Aggressively manage-- Consider alternative process
- Low- Monitor